interior of Germany quite a different race of tame oxen was found, much less in size, with smaller horns, and often without any: this will be treated of in the next article.

This same small race was, without doubt, found among the Germanic tribes also here in Scandinavia, where the inhabitants, accustomed to small cattle, looked upon those introduced by the Jötens as so enormously large. That this race might exist at one and the same time, and in the same country, both wild and tame, is not more extraordinary than that the *reindeer* in Lapland and the *swine* in the whole of south and central Europe should yet exist in the same tracts both in a wild and tame state.

That the wild Urox from the earliest times was an object of chase to the inhabitants here, is proved beyond contradiction by the before-mentioned skeleton preserved in the museum at Lund. This race of wild oxen has never lived in Scandinavia further north than Scania, and even here the fossil remains occur for the most part in the districts of Skytts, Bara and Wemmenhög. Once only have I obtained a skull from Allerum in the district of Luggude.

We perhaps may be astonished at the thought that so colossal an animal as an ox of this race, whose natural food was grass, could winter in a country such as this, where the snow covers the fields often during five to six months of the year, and where the grass during that period either failed or was inaccessible. But our astonishment ceases when we see how the cattle support life during the winter in the forest tracts; with what avidity they bite off and devour the tender branches with their buds, and the catkins of birch, hazel, sallow and other species of willow. Those places where the Urox wintered were certainly thickly grown with the above-named trees, and from them it sustained life. It is not more surprising than to see the Elk live and winter in climates which are much more severe than that in which the Urox existed.

[To be continued.]

XXX.—*Observation of some of the Phases of Development of the* Trichodina pediculus (?). By J. T. Arlidge, A.B., M.B. (Lond.), Member and Student in Anatomy of the Royal College of Surgeons.

[With a Plate.]

In examining the contents of a bottle of water procured from a pool in the swampy part of Hampstead Heath, in the past month (July), and during the drought prevailing at that time, I encountered an animalcule which I determined to be, most probably, the *Trichodina pediculus* (Ehr.). Perceiving that the animal was disposed to remain in the same locality under the mi-

croscope, and possessed in its interior several globules about a clear nucleus, indicating an aptness for ulterior changes, I determined to prosecute a further observation of it.

Occupying about the centre of the being was a distinct, clear nucleus*, and around this were arranged six or seven granular greenish globules, with interspersed particles or granules. The circumference was also furnished with a single row of long and large cilia, which caused the animalcule to rotate on its own axis, without altering its relative position (Pl. VII. B. fig. 1).

After observation had been continued a little while, most probably from a change of position of the creature, an interior, contained circle came into view, eccentric to the outer one so far, that an interval was left between the two for about half of their periphery, whilst in the remaining half the two spheres were in apposition. This interval left between the two had a rather darker colouring, owing to its finely granular character, being minutely dotted as in engraving (fig. 2).

These appearances were present about half-past one o'clock P.M. Moreover, at the same time that the two circles came under notice, the inner one was observed to rotate independently of the outer one, and indeed in the contrary direction,—a result I believe due (judging however from some slight indications only) to its surface being clothed with delicate cilia. Thus, the cilia of the external tunic bent themselves to the left†, producing a motion from right to left, whilst the inner one revolved turning from left to right. This contrariety in the direction of the revolution of the two spheres was very observable, being, at this period and for some time afterwards, very active.

In process of time the motion of the contained circle waxed more rapid than that of the external, and seemed to impede the latter; at least, the rotation of the outer sphere became irregular, and was altogether slower than when first witnessed.

Between two and three o'clock the number of included globules had decreased; and instead of six or seven about the pellucid nucleus, only four could be discovered, but these were of larger size than those heretofore noticed. One of the four seemed more granular than the rest, and deeper seated; another, of the largest size, had one-half of its cavity clear, the other occupied with green granular matter. The remaining two were tolerably clear. Scattered in the interspace between the vesicles were some rounded granular green masses about one-fourth the size of the former, and, in addition, the common formless green particles (fig. 3).

* This nucleus would, according to Ehrenberg's ideas, be called the testis or sperm-cell.

† I speak here of the apparent directions assumed, viewed under the microscope: hence the real directions are just the reverse.

At three o'clock a similar character prevailed; two, however, of the vesicles having grown larger than the other two.

At four o'clock the selfsame two larger ones had attained to double the size of the two others, and one of them exceeded the rest, and appeared to contain in its interior two rounded green nuclei. The two smaller ones now hardly surpassed the rounded green granules spoken of (fig. 4).

At five o'clock two large vesicles were visible, and one smaller one of about one-fourth their size. The nucleus could still be detected about the centre of the animalcule, by a delicate pellucid outline, encroached upon and partly concealed by the peripheries of the two developing cells of the interior (fig. 5).

About six o'clock the two large vesicles had further augmented in size, and occupied the greater part of the area of the entire animal. One of these had in or upon it the two small granular masses described. The outline of the original nucleus was still perceptible.

The two growing cells had now nearly come into contact, and every minute hastened the apposition which presently occurred, and in about another half-hour the two vesicles had blended together, a constriction only indicating the previous line of separation. Rather to one side of this constriction, and engaged within the periphery of the coalesced cells, thus occupying nearly the centre of the animal, the outline of a third vesicle could be seen, probably the original nucleus. Again, on the side opposite to the last vesicle—on that, viz. in which the gap of the mouth was perceptible,—was another sac, overlying slightly the margin of the large constricted coalesced cell, at the point of constriction, and containing granules in its interior (fig. 6).

The original rotundity of the animalcule had become, to some extent, already interfered with by the development of the contained cell; but this interference was destined to proceed; for now the outer tunic began to protrude at one pole, in the long axis of the enlarging interior cell, that is, in the direction in which the latter exerted its outward pressure. This tendency of the animal to increase in one direction continued, and an oval, and afterwards a pyriform figure was attained.

The two green masses, described in one of the now-coalesced cells, occupied a position at the projecting part of the animalcule, remaining distinct (fig. 7).

The great cell would seem now to have undergone some degree of contraction on itself, for it became more globular, the constriction almost disappearing, and left a larger interval at the opposite end of the animal to that from which it protruded. In the meanwhile, the sac described as existing on the same side of the animalcule as the mouth, increased rapidly in its dimensions, so much so as to compress the larger one, forming for

itself a hollow in its wall (fig. 8). Moreover, the rotatory motion became very slow and feeble, and although the external large cilia still flapped, bending towards the left, no motion occurred in that direction, save a slight oscillation of the lower half; whilst the motion of the inner mass was irregular and slow.

During the next quarter of an hour, the animalcule went on enlarging where occupied by the growing cells, the primary one, now spherical, protruding strongly: and, by reason of this cell having now nearly equalled in size the original being, the whole appeared like an animalcule in process of transverse fission (fig. 9).

The second cell, which previously had occupied rather a lateral position with reference to the primary one, was now situated almost entirely beneath it. This second and smaller cell also was the only one which could be properly said to be included within the parent form, the larger one being but an appendage. The only portion which would seem to retain the latter *in situ*, was one—containing granular matter and some globules like the rest of the parent substance,—extending upwards for a short distance as a lateral band.

The revolution of the animal seemed now to cease for a little while, but presently was resumed feebly and irregularly; the external cilia however only causing a jerking movement of the lower part.

During the later changes, the cilia, which primarily fringed the entire margin, were now seen on the lower one—that viz. which remained of the original periphery—and also, owing to the transparency of the animal, along a line behind and just below that along which fission was about to occur (fig. 9).

At seven o'clock, the lateral band attaching the budding cell to its parent had retracted to within a little distance of its base: the growth of the second cell had much advanced, and by its upward pressure against the primary sac, and the lateral pressure of the walls of the parent animal, it had assumed an irregular shape; but its cavity remained quite diaphanous, excepting in its lower part, where a few fine granules were dispersed (fig. 10).

On one side of the two developing cells a small transparent globule existed, along with three or four others, and some amorphous particles, in the substance of the parent being. The cilia had apparently decreased in size—or at least in distinctness and energy, and at half-past seven they had disappeared, motion in them having previously been arrested (fig. 10).

At about a quarter to eight o'clock P.M. the first-formed cell had rendered itself almost independent of its parent, and was bent to one side. The second sac had much increased in size (fig. 11).

Having withdrawn my attention for a moment to complete the

sketch of the animalcule at this stage of development, it happened unfortunately, that, in the instant, the first vesicle had detached itself and floated away, leaving the second free at the margin.

Moreover, it is to be noted, that, after the disappearance of this first sac, two spherical granular bodies similar to those I had thought to be present in it were still perceptible, occupying the same relative position to one another (fig. 12).

Watching the progress of the second sac up to eight o'clock, I saw it gradually make its way outwards, leaving more and more of the parent-being free. The latter still presented numerous small globules and greenish particles. Having subsequently made compression, the process of detachment was hastened, and at length completed, the second sac becoming independent. However, this interference with the natural progress of development seemed to arrest its activity, for the detached bud showed no indication to move away, and the parent animal was left broken and misshapen, but still retaining its green globules and particles (fig. 12).

Remarks.—The process of development above described may be called one of internal gemmation, and is distinct from that of spontaneous fission, as detailed by authors, although in some of its phænomena and phases it may resemble it. M. Dujardin would restrict the modes of propagation of the true Infusoria, or so-called Polygastrica, to that by spontaneous fission, and, occasionally, by gemmation. But in the animalcule observed by me, we certainly find another mode in operation, more akin to generation by ova, which Ehrenberg considers to occur, although that most able microscopist would seem to have founded his opinion on other observed appearances, interpreted by Dujardin as due to the process of 'diffluence.'

It would have been very gratifying to me to have been enabled to follow the detached bud, and to have watched the changes it might have undergone. I have since met with diaphanous vesicles similar in character, devoid of any distinct nucleus, containing only some small particles of greenish matter, but have never been able to discover a very decisive progress in their development. However, this fact is certain, that the product of the animalcule observed did not partake of its distinctive characters, but was merely a simple non-ciliated cell. Such characters truly might be subsequently developed in it, or in another being derived from it, in accordance with the phænomenon of 'alternation of generation' of Steenstrup, or with the truth-bearing hypothesis of Prof. Owen, of an active 'spermatic force.'

It being much more my purpose in writing this paper to record an observation than to speculate upon it,—leaving the latter to others more capable than myself,—I shall conclude by merely

stating that most of the phænomena I have traced were also observed by my friends and fellow-students at the College, Messrs. Hulme and Hallett.

BIBLIOGRAPHICAL NOTICES.

The Rudiments of Botany: a familiar Introduction to the Study of Plants. By A. Henfrey, F.L.S. &c. London, Van Voorst, 1849. 24mo. Pp. 249.

We have often been asked to point out some book by which a beginner might easily attain a knowledge of the more elementary parts of botany, and have always felt much difficulty in giving a satisfactory answer to the question. The above-named work has now supplied the want, and in future we shall at once direct the inquirer's attention to it. It is written in simple language, so as to be easily understood by those who are totally without botanical knowledge, and nevertheless contains nearly all that preliminary information which it is requisite to obtain before approaching the more elaborate 'Introductions to Botany,' such as the 'Outlines of Botany' by the same author, or Professor Balfour's 'Manual.' Those who desire, as we hope all who have gone so far will do, to obtain still more minute scientific knowledge, will then study Dr. Lindley's excellent 'Introduction.' It is not however absolutely necessary, for such as only contemplate attaining a knowledge of the names of British plants, to extend their reading, at first, beyond the nice little book before us, since they will find in it all that is absolutely requisite to enable them to use the books descriptive of our native plants. We say *absolutely* necessary; for we certainly do not believe that those who have attained to that amount of knowledge will be satisfied to remain ignorant of the many highly interesting subjects included in physiological, not to mention the more curious and abstruse parts of systematic, botany which are elucidated in the more elaborate works, which, having got over the difficulties attending the attainment of the rudiments of the science, they will then be enabled to read with interest and ease.

We think that Mr. Henfrey has performed the task which he has undertaken in a very satisfactory manner, nor have we any objections to make to the plan which he has followed, but think that he will be able in a future edition (for which we expect an early call) in some degree to improve the language of his book: not that much improvement is requisite, but such a book cannot be written in language of too simple and perspicuous a character. In some few cases an error in the punctuation has caused some slight ambiguity which will be immediately detected by its author. There are also a few typographical errors which require correction. These ambiguities and errors present no difficulty to the botanical reader, but may be the cause of error or inconvenience to the beginners to whom the book is addressed. For instance (p. 34), the wallflower, pink and